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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/016,729	11/30/2001	Bin Zhao	12569-08/NEC	5389

7590

06/17/2003

STRADLING YOCCA CARLSON & RAUTH

IP Department

P.O. Box 7680

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Newport Beach, CA 92660-6441

EXAMINER

JUBA JR, JOHN

ART UNIT

PAPER NUMBER

2872

DATE MAILED: 06/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/016,729

Applicant(s)

ZHAO, BIN

Examiner

John Juba

Art Unit

2872

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 March 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 4-8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 4-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
- 4) ☒ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Errata

In the last Office action (paper #2), on the examiner's list of references cited (PTO-892), the citation for Sterling, et al should read U.S. Patent number 6,452,725. The examiner has made a pen-and-ink correction in the Office file. Applicant is asked to make a similar correction.

Also in the last Office action, on Page 4, at line 11, "Lunt (U.S. Patent number 6,2155,802)" should read - - "Lunt (U.S. Patent number 6,215,802) - - . The examiner has made a pen-and-ink correction, and asks that Applicant make a similar correction.

Specification

The specification is objected to because the related application data on Page 1 is incomplete.

Claim Rejections - 35 USC § 112

Claims 4 – 8 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Each of claims 4 – 8 recites an expression for the relationship among the variables associated with the recited structure. However, not all of the terms are defined. Accordingly, the claims are confusing and/or indefinite as to the cooperation of

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the elements' thermal characteristics. In all of the claims, an expression for "L" is needed, or a similar definition. In claims 7 and 8, wherein α_n , α_L , n_g , n_a , and α_{ULE} are needed.

Claims 7 and 8 are indefinite in reciting the holding material as being of "low-expansion", whereas the specification provides no guidance as to what range of expansion characteristics would be considered "low". Instead, a typical expansion coefficient range is described only for "ultra-low expansion" materials. Lacking guidance as to what range of expansion coefficients would be considered "low", the scope of the claim cannot be determined.

Allowable Subject Matter

Claims 4 – 8 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action. The following is a statement of reasons for the indication of allowable subject matter: The prior art, taken alone or in combination, fails to teach or to fairly suggest a method or an apparatus in which a solid light transmissive material is fixed at one end to an ultra low expansion holder with its second end substantially free to move with respect to the holder, particularly wherein the thermal coefficient of optical path length of the assembly is given by Equation (11) and wherein

the terms of that equation are either minimized or substantially canceled among each other, as recited in claim 4; or

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the first two terms of that equation substantially cancel each other, and L_g is much greater than L_a such that the third term is approximately zero, as recited in claim 6;

at least two terms of the equation substantially cancel each other and the rest are minimized, as recited in claim 7; or wherein

each of the contributing terms is substantially canceled among the others, as recited in claim 8.

Response to Amendment

Applicant's efforts to place this application in condition for allowance are noted with appreciation. The examiner regrets the delay in identifying the above-noted deficiencies, and apologizes for any inconvenience.

During an interview conducted with Mr. Norman Carte, the examiner forwarded a proposed amendment to Applicant's representative by facsimile (see attached interview summary). The proposed changes were believed to overcome the above-noted deficiencies without a loss of generality. This application was on the examiner's docket for over two months, whereby the examiner was required to complete an Office action by Saturday, June 14th. No response having been received from Applicant, this office action was prepared in lieu of a notice of allowability.


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Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Juba whose telephone number is (703) 308-4812. The examiner can normally be reached on Mon.-Fri. 9 - 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cassandra Spyrou can be reached on Mon.- Thu., 9 - 5. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.


JOHN JUBA
PRIMARY EXAMINER
Art Unit 2872

June 16, 2003

Interview Summary	Application No.		Applicant(s)	
	10/016,729		ZHAO, BIN	
	Examiner		Art Unit	
	John Juba		2872	

All participants (applicant, applicant's representative, PTO personnel):

(1) John Juba. (3) _____.

(2) Mr. Norman E. Carte. (4) _____.

Date of Interview: 09 June 2003.

Type: a) ☒ Telephonic b) ☐ Video Conference
c) ☐ Personal [copy given to: 1) ☐ applicant 2) ☐ applicant's representative]

Exhibit shown or demonstration conducted: d) ☐ Yes e) ☐ No.
If Yes, brief description: _____.

Claim(s) discussed: (none).

Identification of prior art discussed: _____.

Agreement with respect to the claims f) ☐ was reached. g) ☒ was not reached. h) ☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: The examiner forwarded a proposed amendment by facsimile (placed in filed herewith). The amendment was intended to define the terms and expressions used in the claims. Applicant's representative will contact the examiner after consideration of the proposal.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.



Examiner's signature, if required

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.



Group 2870 FACSIMILE

Date: 9 June 2003

To: Mr. Norman E. Carte

Firm: Myers, Dawes, Andras & Sherman LLP

Facsimile Number: (1) (949) 223-9610

From: John Juba

Facsimile Number: (703) 746-4723

Your Docket Number: CIR1.PAU.08

U.S. Appl. Serial Number: 10/016,729

Message: Office records (by Reg. #) still reflect Mr. Carte's Pasadena, CA address. The correspondence address for this application has not been changed. Change of Address needs to be filed on a separate paper. Any such paper apparently has been separated from the file wrapper and is not on file. The revocation and substitute Power of Attorney mentioned in the last response (March 10, 2003) apparently were separated from the file wrapper and are not on file. Attached, please find a proposed examiner's amendment as would define the terms variables used in the claims. The expression for "L" was taken from Eq. (5) on Page 12 of the specification. In claims 7 and 8, an "ultra-low" expansion material must be intended, since that is the expansion coefficient given, and since the specification does not provide guidance as to what would be considered "low expansion" as distinguished from "ultra-low" expansion.

Number of Pages Including Cover: 7

If you do not receive all pages of this transmission, contact JOHN JUBA at (703) 308-4812.

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Examiner's Amendment (proposed)

In the Specification:

Page 1, paragraph [002] now reads

- - [0002] This patent application is related to co-pending patent application Ser. No. 09/876,602, filed Jun. 7, 2001 and entitled BIREFRINGENT DEVICES (Docket Number 12569-02), and is related to co-pending patent application Ser. No. 09/876,819, filed Jun. 7, 2001 and entitled COMB FILTER FOR DENSE WAVELENGTH DIVISION MULTIPLEXING (Docket Number 12569-11), and is related to co-pending patent application Ser. No. 09/876,368, filed Jun. 7, 2001 and entitled INTERLEAVER USING SPATIAL BIREFRINGENT ELEMENTS (Docket Number 12569-03), and is related to co-pending patent application Ser. No. 09/891,795, filed Jun. 25, 2001 and entitled APPARATUS FOR CHANNEL INTERLEAVING IN COMMUNICATIONS (Docket Number 12569-04), and is related to co-pending patent application Ser. No. 10/016,801, filed November 30, 2001 and entitled TEMPERATURE COMPENSATING REFLECTIVE RESONATOR (Docket Number 12569-07), all of which are commonly owned by the Assignee of this patent, the entire contents of all of which are hereby expressly incorporated by reference. - - -

In the Claims:

Claims 4, 6, 7, and 8 now read as follows:

4. (proposed) A temperature compensating phase delay element comprising:

ultra-low expansion holding material defining a distance between its first and second ends;

a solid light transmissive material attached to the ultra-low expansion holding material such that a first end surface of the solid light transmissive material is substantially fixed in position with respect to the first end of the ultra-low expansion holding material and a second end surface of the solid light transmissive material is generally free to move with respect to the ultra-low expansion material;

a gap formed along the distance defined by the ultra-low expansion material;
wherein a thermal coefficient of optical path length is given by the formula

$$\begin{aligned}\alpha_{OP} &= \frac{1}{OP} \frac{dOP}{dT} \approx \frac{1}{n_g} \frac{dn_g}{dT} + \frac{1}{L_g} \frac{dL_g}{dT} \frac{n_g - n_a}{n_g} + \frac{L_a}{L_g} \frac{dn_a}{dT} \frac{1}{n_g} + \frac{n_a}{n_g} \frac{dL}{dT} \\ &= \alpha_n + \alpha_L \frac{n_g - n_a}{n_g} + \alpha_a \frac{n_a L_a}{n_g L_g} + \alpha_{ULE} \frac{n_a}{n_g}\end{aligned}\quad (11)$$

wherein α_n is the thermal coefficient of the refractive index for the solid light transmissive material, α_L is the thermal expansion coefficient for the solid light transmissive material;

n_g is the index of refraction for the solid light transmissive material, n_a is the index of refraction for a material disposed intermediate the second end surface of the solid light transmissive material and the second end of the ultra-low expansion material, α_a is the thermal coefficient of refractive index for the material disposed intermediate the second end surface of the solid light transmissive material and the second end of the ultra-low expansion material, L_a is the distance between the second end surface of the solid light transmissive material and the second end of the ultra-low expansion material, L_g is the thickness of the solid light transmissive material, L equals $L_a + L_g$, and α_{ULE} is the thermal coefficient of expansion for the ultra-low expansion material; and

wherein the thermal coefficient of optical path length is mitigated by at least one of:

minimizing terms of Equation 11; and

substantially canceling the terms among one another of Equation 11.

6. (Proposed) A temperature compensating light transmissive element comprising:

ultra-low expansion holding material having first and second ends; a solid light transmissive material attached to the first end of the ultra-low expansion holding material such that a first end of the solid light transmissive material is substantially fixed in position with respect to the ultra-low expansion holding material and a second end of the solid light transmissive material is generally free to move with respect to the ultra-low expansion material;

a gap formed between the second end of solid light transmissive material and the second end of the ultra-low expansion material;

wherein a thermal coefficient of optical path length is given by the formula

$$\begin{aligned}\alpha_{OP} &= \frac{1}{OP} \frac{dOP}{dT} \approx \frac{1}{n_g} \frac{dn_g}{dT} + \frac{1}{L_g} \frac{dL_g}{dT} \frac{n_g - n_a}{n_g} + \frac{L_a}{L_g} \frac{dn_a}{dT} \frac{1}{n_g} + \frac{n_a}{n_g L_g} \frac{dL}{dT} \\ &= \alpha_n + \alpha_L \frac{n_g - n_a}{n_g} + \alpha_a \frac{n_a L_a}{n_g L_g} + \alpha_{ULE} \frac{n_a}{n_g}\end{aligned}\quad (11)$$

wherein α_n is the thermal coefficient of the refractive index for the solid light transmissive material, α_L is the thermal expansion coefficient for the solid light transmissive material;

n_g is the index of refraction for the solid light transmissive material, n_d is the index of refraction for a material disposed [dispose] intermediate the second end of the solid light transmissive material and the second end of the ultra-low expansion material, α_a is the thermal coefficient of refractive index for the material disposed [dispose] intermediate the second end of the solid light transmissive material and the second end of the ultra-low expansion material, L_a is the distance between the second end of the solid light transmissive material and the second end of the ultra-low expansion material, L_g is the thickness of the solid light transmissive material, L equals $L_a + L_g$ and α_{ULE} is the thermal coefficient of expansion for the ultra-low expansion material; and

wherein the thermal coefficient of optical path length is mitigated by configuring the light transmissive material such that the first two terms of Eq. (11) substantially cancel one another, L_g is much greater than L_a such that the third term of Eq. (11) is approximately zero, and α_{ULE} is substantially zero.

7. (Proposed) A method for mitigating undesirable effects due to temperature changes in an optical phase delay element, the method comprising:

holding a first end of a light transmitting material approximately fixed with respect to a first end of an ultra-low expansion [a low-expansion] material and allowing a second end of the light transmissive material [for] to move with respect to a second end of the ultra-low expansion [low-expansion] material;

wherein a thermal coefficient of optical path length is given by the formula

$$\begin{aligned}\alpha_{OP} &= \frac{1}{OP} \frac{dOP}{dT} \approx \frac{1}{n_g} \frac{dn_g}{dT} + \frac{1}{L_g} \frac{dL_g}{dT} \frac{n_g - n_a}{n_g} + \frac{L_a}{L_g} \frac{dn_a}{dT} \frac{1}{n_g} + \frac{n_a}{n_g} \frac{dL}{dT} \\ &= \alpha_n + \alpha_L \frac{n_g - n_a}{n_g} + \alpha_a \frac{n_a L_a}{n_g L_g} + \alpha_{ULE} \frac{n_a}{n_g}\end{aligned}\quad (11)$$

wherein α_n is the thermal coefficient of the refractive index for the solid light transmissive material, α_L is the thermal expansion coefficient for the solid light transmissive material;

n_g is the index of refraction for the solid light transmissive material, n is the index of refraction for a material disposed intermediate the second end surface of the solid light transmissive material and the second end of the ultra-low expansion material, α_a is the thermal coefficient of refractive index for the material disposed intermediate the second end surface of the solid light transmissive material and the second end of the ultra-low expansion material, L_a is the distance between the second end surface

of the solid light transmissive material and the second end of the ultra-low expansion material, L_g is the thickness of the solid light transmissive material, L equals $L_a + L_g$, and α_{ULE} is the thermal coefficient of expansion for the ultra-low expansion material;

wherein at least two contributing terms of equation (11) substantially cancel one another; and

wherein the rest of the contributing terms of equation (11) are approximately minimized.

8. (Proposed) A method for mitigating undesirable effects due to temperature changes in an optical phase delay element, the method comprising:

holding a first end of a light transmitting material approximately fixed with respect to a first end of an ultra-low expansion [a low-expansion] material and allowing a second end of the light transmissive material [for] to move with respect to a second end of the ultra-low expansion [low-expansion] material;

wherein a thermal coefficient of optical path length is given by the formula

$$\begin{aligned}\alpha_{OP} &= \frac{1}{OP} \frac{dOP}{dT} \approx \frac{1}{n_g} \frac{dn_g}{dT} + \frac{1}{L_g} \frac{dL_g}{dT} \frac{n_g - n_a}{n_g} + \frac{L_a}{L_g} \frac{dn_a}{dT} \frac{1}{n_g} + \frac{n_a}{n_g L} \frac{dL}{dT} \\ &= \alpha_n + \alpha_L \frac{n_g - n_a}{n_g} + \alpha_a \frac{n_a L_a}{n_g L_g} + \alpha_{ULE} \frac{n_a}{n_g}\end{aligned}\quad (11)$$

wherein α_n is the thermal coefficient of the refractive index for the solid light transmissive material, α_L is the thermal expansion coefficient for the solid light transmissive material;

n_g is the index of refraction for the solid light transmissive material, n_a is the index of refraction for a material disposed intermediate the second end surface of the solid light transmissive material and the second end of the ultra-low expansion material, α_a is the thermal coefficient of refractive index for the material disposed intermediate

the second end surface of the solid light transmissive material and the second end of
the ultra-low expansion material, L_a is the distance between the second end surface
of the solid light transmissive material and the second end of the ultra-low expansion
material, L_g is the thickness of the solid light transmissive material, L equals $L_a + L_g$,
and α_{ULE} is the thermal coefficient of expansion for the ultra-low expansion material;
and

wherein [each] all contributing [term] terms in Equation (11) substantially cancel
[one] each another.